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## The Effect of EHR-Integrated Patient Reported Outcomes on Satisfaction with Chronic Pain Care

**Christopher A. Harle, PhD,**

Indiana University, Indianapolis (IUPUI)

**Nicole M. Marlow, PhD,**

University of Florida

**Siegfried O.F. Schmidt, MD, PhD,**

University of Florida

**Jonathan J. Shuster, PhD,**

University of Florida

**Alyson Listhaus, MPH,**

University of Florida

**Roger B. Fillingim, PhD, and**

University of Florida

**Robert W. Hurley, MD, PhD**

Medical College of Wisconsin

### Abstract

**Objective**—Given its complexity, chronic noncancer pain presents an opportunity to use health information technology (IT) to improve care experiences. The objective of this study was to assess whether integrating patient-reported outcomes (PRO) data in an electronic health record (EHR) affects providers and patient satisfaction with chronic noncancer pain care.

**Study Design**—We conducted a pragmatic cluster randomized trial involving four family medicine clinics.

**Methods**—We enrolled primary care providers (PCPs) and their patients with chronic noncancer pain. In the first seven months (education phase), PCPs in intervention practices received education on how to use PROs for pain care. In the second seven months (PRO phase), patients in intervention practices reported pain-related outcomes upon arrival at their visits. PROs were

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**Corresponding Author:** Christopher A. Harle, 1050 Wishard Blvd, RG 5134, Indianapolis, IN 46202-2872, phone: 317-274-5396, fax: 317-274-3443, [charle@iu.edu](mailto:charle@iu.edu).

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immediately reported to PCPs through the EHR. Control group PCPs provided usual care. We compared intervention and control practices in terms of provider and patient satisfaction with care.

**Results**—During the education phase, patients' mean ratings of their visits did not differ between control and intervention (9.33 vs. 9.08,  $p=0.20$ ). During the PRO phase, patients' mean ratings did not differ between control and intervention (9.28 vs 9.01,  $p=0.20$ ). Similarly, there were no differences between the intervention and control groups in terms of provider satisfaction.

**Conclusion**—Delivering EHR-integrated PROs did not consistently improve patient or provider satisfaction. Positively, we found no evidence that the PRO tools negatively affected satisfaction. Future studies and technological innovations are needed to translate point-of-care health IT tools to improvements in patient and provider experiences.

## Keywords

Health IT; Healthcare management; Pain management; Opioid Abuse

## Introduction

More than a decade ago, the U.S. federal government began significantly investing in health information technology (IT). Today, 95% of hospitals and 56% of office-based providers use certified Electronic Health Records (EHRs).<sup>1,2</sup> Thus, the U.S. healthcare system has more infrastructure than ever upon which health IT tools can be implemented to support better information access, sharing, and decision making by healthcare providers and patients. Still, we lack sufficient research to understand if and when health IT tools affect patient and provider experiences.<sup>3–7</sup> Without these studies, we lack the evidence needed to overcome the challenges that healthcare providers face in embracing health IT to meaningfully improve care for complex and costly patients.

Affecting more than 100 million Americans at a cost of over \$600 billion annually<sup>8</sup>, chronic noncancer pain presents an opportunity to utilize health IT and other interventions to improve care. Chronic noncancer pain conditions, such as low back pain and diabetic neuropathy, have complex biopsychosocial roots, symptoms, and comorbidities.<sup>8</sup> Moreover, chronic noncancer pain care is directly linked to the ongoing public health epidemic of prescription opioid pain medication use, misuse, and abuse that results in over 350,000 emergency department visits<sup>9</sup> and 14,000 deaths each year.<sup>10</sup> Given the complexity of pain conditions and poor outcomes associated with chronic opioid therapy, many providers who care for chronic noncancer pain, and their patients, are dissatisfied with their respective experiences in providing and receiving care.<sup>11–15</sup>

Point-of-care health IT tools may improve pain care satisfaction by collecting and aggregating valuable health information. For example, clinical decision support tools could give providers easier and more reliable access to information on patients' physical and psychological symptoms. In the case of symptoms, patients must report them directly, such as through discussions with clinicians, written questionnaires, or electronic questionnaires. Today, systems developers, researchers, and healthcare providers are engaged in learning how to best collect and integrate patient-reported outcomes (PROs) into care using health

IT.<sup>16–22</sup> Researchers have also called for studies that focus on PROs role in patient-provider relationships.<sup>23</sup> On one hand, IT-integrated PROs allow providers to collect unique and clinically-relevant information on patients' symptoms and needs, which may improve care planning, patient-provider communication, and satisfaction. On the other hand, traditional clinical routines and norms in patient-provider communication may inhibit providers' ability to process and respond to PRO information in ways that improve satisfaction with care.<sup>24</sup> Concerns about poor health IT usability and usefulness<sup>7,25</sup> could also inhibit IT-integrated PROs from positively affecting patient and provider satisfaction, especially if PRO information is collected but not discussed or acted on during visits. Still, several prior studies have found positive effects of PROs on patient-provider communication and patient satisfaction.<sup>26,27</sup>

In this study, we describe a pragmatic cluster randomized trial involving primary care providers (PCPs) and their patients with chronic noncancer pain. We examined whether providing PCPs with education on multidisciplinary pain care and then systematically collecting pain-related PROs in the EHR would affect PCP and patient satisfaction with care. Given prior research evidence on low satisfaction with pain care and expressed need within our health system for improvements in pain care satisfaction,<sup>28</sup> we hypothesized that the education and EHR-integrated PROs would each increase provider and patient satisfaction with pain care. The results of this study will inform the literature on how health IT affects patient and provider experiences with care.

## Methods

We conducted a pragmatic cluster randomized trial in four family medicine clinics affiliated with an academic health center (see Appendix section 1 for a diagram of the trial flow).<sup>29–31</sup> The four clinics were matched as two pairs based on practice and patient demographics and randomized to intervention or control groups. For PCPs in intervention clinics, we implemented pain-related education modules and an EHR-integrated PRO system. The EHR (Epic), served as a conduit for collecting and communicating the PROs to providers at the point of care. We registered the study as a randomized controlled trial with [ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study?term=NCT02188667) (Identifier: NCT02188667). Our university's Institutional Review Board approved the study.

## Participants

We recruited PCPs (physicians and physician assistants) from the four clinics. We also recruited patients, ages 18–89, whose health record history indicated chronic musculoskeletal, headache, or neuropathic pain and no cancer (see Appendix section 3). Upon arriving for a visit with a participating provider, eligible patients received a written notice about the study and a follow-up phone survey about their visit satisfaction. Patients could refuse to participate in the survey by signing an opt-out form or declining to complete the phone survey when called.

## Intervention

The intervention involved two phases. First, we provided a six module education curriculum that was available to providers for seven months. The education emphasized evidence-based, multimodal, and comprehensive pain care and was based on published evidence-based guidelines and systematic reviews.<sup>32–34</sup> The education also included training on PRO instruments that providers could use to assess risks and benefits of different treatment modalities<sup>35</sup> and patients' levels of pain, function, sleep, and mental health.

Second, we implemented the EHR-integrated PRO system. We evaluated the effect of this system for seven months. When patients arrived for a visit with a participating provider, a clinic staff member asked them to complete a series of PRO surveys using a tablet computer and the Collaborative Health Outcome Information Registry (CHOIR) software.<sup>36,37</sup> We used CHOIR to collect 13 measures and send results to the Epic EHR for providers to view during patient visits. Nine measures (pain interference, pain behavior, fatigue, anger, depression, sleep disturbance, sleep-related impairment, anxiety, and physical function) were assessed via computer-adaptive instruments from the National Institutes of Health (NIH) Patient Reported Outcomes Measurement Information System (PROMIS) system.<sup>38,39</sup> We also measured pain catastrophizing [20], risk of opioid-related aberrant behavior<sup>35</sup>, pain intensity,<sup>40</sup> and location of pain.

Immediately following completion, CHOIR sent numeric PRO assessment results to the EHR, where it could be accessed by providers. Each PROMIS measure was recorded in the EHR's results module both as a t-score and a population percentile. In addition, the system provided narrative clinical interpretation for any scores with established interpretations. Providers could insert the numeric results and clinical interpretations in their notes and graph PRO results over time alongside medication start and stop dates.

## Outcomes

The two primary outcomes were patient satisfaction and provider satisfaction with receiving and providing pain care respectively (see Appendix sections 4 and 5 for survey questions). We collected patient satisfaction after each study visit. First, we asked patients to rate their overall health care on a scale of 0 (worst visit possible) to 10 (best visit possible). Second, patients who reported discussing pain with their provider during the visit were asked two questions adapted from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.<sup>41</sup> The first item addresses patient perception that their provider did everything he/she could to help with pain. The second item addresses patient confidence that their pain will be well controlled in the future based on their visit experience.

We measured provider satisfaction monthly starting immediately prior to implementing the education component of the intervention and then monthly for 14 months. This survey included a 14-item questionnaire assessing general experiences and satisfaction with providing care to patients with chronic pain. The questionnaire was modified from a visit-specific physician satisfaction questionnaire<sup>42</sup>, such that the item wordings referred to general satisfaction with visits by patients who have chronic pain. The 14 items included one global satisfaction measure and multi-item subscales assessing the quality of the patient-

provider relationship, appropriate use of time during visits, adequacy of data collection during visits, and patients' cooperation during visits. Each item contained a five-point agree/disagree response scale anchored by "strongly disagree" and "strongly agree."

### Sample Size

Our a priori sample size estimations were based on the 0–10 patient satisfaction measure, accounting for clustering within providers. We expected unbalanced enrollment (11 PCPs control and 9 PCPs intervention) and a uniformly distributed random number of patients per PCP between 20 and 40 (606 patients per phase). The following simulated powers with 20,000 replications were obtained to detect a true mean difference in scores of 1.5 on a 0 to 10 point scale at two-sided type I error of 5%: [ $\sigma_{\text{Between Providers}}$ ,  $\sigma_{\text{Within Providers}}$ , Power] respectively: [1.0, 1.5: 85%], [1.0, 2.0: 83%], [1.0, 2.5: 81%].

### Analysis

For patient satisfaction outcomes, we first computed a personal mean for each physician within phases and compared the intervention and control groups using a weighted least squares analysis with weights proportional to the physician total sample size. The independent variable was intervention group, i.e., intervention versus control. Next, we assessed the differences between the education phase and the PRO phase for intervention versus control physicians. We used the paired difference in physician mean between the phases using weighted least squares as above. The model for the PRO phase-education phase difference in mean satisfaction for physician  $j$  ( $Y_j$ ) was:  $Y_j = \beta_0 + \beta_1 T_j + e_j$ , where  $T_j$  is 0 (control) or 1 (intervention) and  $e_j$  is random error for physician  $j$ . The slope  $\beta_1$  represents the mean treatment difference, asking if the treatment difference depends on the phase.

We assessed within-phase differences in overall provider satisfaction (average across the 14-items) and on the four subscale aggregates. For each analysis, we used linear mixed models with an autoregressive covariance structure. For intervention-control comparisons within each phase, provider identifiers (random), intervention group (fixed), and baseline satisfaction scores (fixed) were independent variables. Next, we estimated differences between phases, with participant identifiers (random) and phase (fixed) as independent variables. We also estimated time and time by intervention fixed effects to assess study time trends and interaction.

### Results

Twenty-one PCPs were enrolled across the four participating clinics, including 11 in the control group and 10 in the intervention group). The average years in practice was 9.7 (Range: 1 – 40), and a total of 2 PCPs reported having formal pain training. The average PCP age was 43.8 years, and 62% were female. Data were collected from 712 unique patients over 1,203 clinical visits. A total of 680 patients had complete data for at least one of the satisfaction outcomes. The average patient age in the intervention group was 55.0 years and 77% were female. Similarly, for the control group the average age was 53.3 years and 72% were female. See Appendix section 2 for detailed patient demographics.

## Patient Satisfaction

During the education phase, patients' mean overall ratings of their visits were 9.33 (out of 10) for control practices and 9.08 for intervention practices, and not significantly different between groups ( $p=0.20$ ) (Table 1). During the PRO phase, patients' mean overall ratings of their visits were 9.28 for control practices and 9.01 for intervention practices, and not significantly different between groups ( $p=0.20$ ). Similarly, patients' mean perceptions that their "doctor did everything he/she could to help you with your pain or discomfort" and confidence "that in the future your pain or discomfort will be well controlled" did not differ significantly between control and intervention groups in either phase ( $p>0.05$ ).

## Provider Satisfaction

At baseline, before offering education, intervention group PCPs reported a mean overall satisfaction with providing pain care of 2.87 (out of 5), compared to 3.01 for the control group. The intervention group's satisfaction increased slightly, but not significantly, by the end of the education phase ( $p=0.17$ ) as well as from the end of the education phase to PRO phase completion ( $p=0.71$ ) (Table 2). A similar result was observed for each of the four satisfaction subscale measures. Furthermore, after adjusting for baseline satisfaction, there were no differences observed between the intervention and control groups within phases (Table 3). The largest control versus intervention difference was a 0.20 higher mean satisfaction with time spent during visits with patients with chronic pain in the intervention group at the end of the PRO phase. However, this difference only approached significance ( $p=0.06$ ). Finally, in testing for a linear time effect and a time by intervention interaction, all 10 time slopes were not significant and all 10 interactions were non-significant ( $p>0.05$ ).

## Discussion

The primary result of our study was that neither multidisciplinary pain care education nor EHR-integrated PROs affected patient or PCP satisfaction. The intervention was intended to improve patient and PCP satisfaction with care. Still, we recognized that implementing a health IT intervention in the context of an existing EHR and clinical workflow constraints could prevent improvements in satisfaction. Indeed, that may be what we observed. Given the challenges in designing and implementing health IT, it is important that the literature reflect pragmatic trials, even when the intervention being studied does not have a positive effect. Thus, our study represents a technologically successful health IT implementation on which future interventions can be built to support patients and providers when dealing with complex chronic conditions. However, our study, like others, provides a cautionary tale about pushing technology and information into clinical encounters.<sup>7,28,43</sup> Even if clinically-relevant information is technically accessible, it does not necessarily mean that it is practically useful.<sup>7,28,43,44</sup>

Introducing PROs into care settings has been shown to positively affect outcomes, including patient and provider satisfaction, in some instances.<sup>26,27</sup> However, the potential effects are likely influenced by several intervening factors, including the format of the intervention, the motivation of patients and PCPs to discuss the information, and alignment of the information with clinical workflow and decision making.<sup>45,46</sup> Our intervention elicited PROs during

existing patient wait times and embedded the results in the EHR, which fit well with existing clinical workflows and the primary IT system that PCPs use. However, it is possible that our intervention was still minimally attended to by PCPs. For example, PCPs may not have found the PROs directly relevant to what they perceived the patients' chief complaint to be. Or, PCPs may have been unsure how to efficiently translate the PRO results into clinical action.<sup>47</sup> These factors underscore the enormous challenges facing designers and implementers in producing health IT tools that are accessible and easily used by clinicians. At the same time, these factors illustrate the fact that deriving value from health IT tools often requires organizational changes, such as workflow redesigns, changing job roles, and shifts in clinician incentives.<sup>48,49</sup> Today, the state of health IT is one of widespread adoption and rapidly increasing electronic data collection. The next hurdle in reliably improving care satisfaction will be to transform data to information, and to integrate that information into effective clinical process.

The pragmatic nature of our study was a strength and a weakness. On one hand, the pragmatic design likely increases the generalizability of our findings to other primary care practices in which pain care is delivered to many patients every day. On the other hand, our study was conducted in a single health system and we fell short of our a priori targeted patient sample size. Also, pragmatic studies can lack tight control over the intensity of the intervention. For example, we noted at times early in the PRO phase of the study, technology malfunctions prevented some enrolled patients from completing surveys. Similarly, providers may not have always attended to PRO information in their EHR during patient visits or attended to them less over time. Such factors may have dampened a potential positive effect, but they also reflect challenges in obtaining practical value from health IT. Also, differences in patient demographics may have biased our results. The two intervention practices had higher proportions of African-American patients and patients with state health insurance (e.g., Medicaid). To the extent that these demographic factors may relate to lower satisfaction with care, this also may have led us to underestimate the intervention's effect.<sup>50–53</sup> Finally, because general patient satisfaction rates were relatively high, even in the early stages of the study, there was little room for the intervention to have a positive effect on this measure. However, the means of the other measures of patient and provider satisfaction, while above the mid-point of the scales, were low enough that they could have improved.

National leaders in health IT and clinical care have emphatically called for progress in the collection and use of standardized electronic data to assess and treat complex chronic conditions, such as pain.<sup>8,18,54</sup> However, our study found that delivering standardized PRO data via an EHR did not consistently improve patient or provider satisfaction. On the positive side, PCPs are often concerned about any interventions that could negatively affect their clinical workflows given pressures for efficiency in caring for many patients. We found no evidence, via quantitative evidence in this study or in qualitative data presented elsewhere<sup>47</sup> that in-clinic PRO assessment and EHR integration negatively affected workflows. Therefore, our study demonstrated the feasibility of PRO-enabled pain care. Still, future studies and innovations are needed to most effectively translate point-of-care health IT tools to consistent improvements in patient and provider experiences.



## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## References

1. The Office of the National Coordinator for Health IT. Hospitals Participating in the CMS EHR Incentive Programs. 2015. <http://dashboard.healthit.gov/quickstats/pages/FIG-Health-Care-Professionals-EHR-Incentive-Programs.php>
2. The Office of the National Coordinator for Health IT. Office-based Health Care Professional Participation in the CMS EHR Incentive Programs. 2015. <http://dashboard.healthit.gov/quickstats/pages/FIG-Health-Care-Professionals-EHR-Incentive-Programs.php>
3. American College of Physicians. Survey of Clinicians: User satisfaction with electronic health records has decreased since 2010. 2013. <https://www.acponline.org/acp-newsroom/survey-of-clinicians-user-satisfaction-with-electronic-health-records-has-decreased-since-2010>
4. Goldzweig CL, Towfigh A, Maglione M, Shekelle PG. Costs and benefits of health information technology: New trends from the literature. *Health Aff.* 2009; 28(2):w282–w293.
5. Hanauer DA, Branford GL, Greenberg G, et al. Two-year longitudinal assessment of physicians' perceptions after replacement of a longstanding homegrown electronic health record: does a J-curve of satisfaction really exist? *J Am Med Inform Assoc.* 2016
6. Irani JS, Middleton JL, Marfatia R, Omana ET, D'Amico F. The use of electronic health records in the exam room and patient satisfaction: A systematic review. *J Am Board Fam Med.* 2009; 22(5): 553–562. [PubMed: 19734402]
7. Rosenbaum L. Transitional chaos or enduring harm? The EHR and the disruption of medicine. *N Engl J Med.* 2015; 373(17):1585–1588. [PubMed: 26488690]
8. Committee on Advancing Pain Research Care Education, Institute of Medicine. *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research.* The National Academies Press; 2011.
9. Crane, E. Emergency department visits involving narcotic pain relievers. Substance Abuse and Mental Health Services Administration (SAMHSA); 2015.
10. Centers for Disease Control and Prevention (CDC). Prescription Opioid Overdose Data. 2016. <http://www.cdc.gov/drugoverdose/data/overdose.html>
11. Dobscha SK, Corson K, Flores JA, Tansill EC, Gerrity MS. Veterans Affairs primary care clinicians' attitudes toward chronic pain and correlates of opioid prescribing rates. *Pain Med.* 2008; 9(5):564–571. [PubMed: 18777608]
12. Harle CA, Bauer SE, Hoang HQ, Cook RL, Hurley RW, Fillingim RB. Decision support for chronic pain care: how do primary care physicians decide when to prescribe opioids? a qualitative study. *BMC Fam Pract.* 2015; 16(1):1–8. [PubMed: 25608667]
13. Matthias MS, Parpart AL, Nyland KA, et al. The patient–provider relationship in chronic pain care: providers' perspectives. *Pain Med.* 2010; 11(11):1688–1697. [PubMed: 21044259]
14. O'Rourke JE, Chen I, Genao I, Panda M, Cykert S. Physicians' comfort in caring for patients with chronic nonmalignant pain. *American Journal of Medical Science.* 2007; 333(2):93–100.
15. Upshur CC, Bacigalupe G, Luckmann R. "They Don't Want Anything to Do with You": Patient Views of Primary Care Management of Chronic Pain. *Pain Med.* 2010; 11(12):1791–1798. [PubMed: 21029353]



16. Cella D, Gershon R, Lai J-S, Choi S. The Future of Outcomes Measurement: Item Banking, Tailored Short-Forms, and Computer Adaptive Assessment. *Qual Life Res.* 2007; 16(S1):133–141. [PubMed: 17401637]
17. Cella D, Riley W, Stone A, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *J Clin Epidemiol.* 2010; 63(11):1179–1194. [PubMed: 20685078]
18. Committee on the Recommended Social and Behavioral Domains and Measures for Electronic Health Records; Institute of Medicine. *Capturing Social and Behavioral Domains and Measures in Electronic Health Records: Phase 2.* Washington, D.C.: The National Academies Press; 2014.
19. Estabrooks PA, Boyle M, Emmons KM, et al. Harmonized patient-reported data elements in the electronic health record: supporting meaningful use by primary care action on health behaviors and key psychosocial factors. *J Am Med Inform Assoc.* 2012; 19(4):575–582. [PubMed: 22511015]
20. Jensen RP, Rothrock N, DeWitt ME, et al. The Role of Technical Advances in the Adoption and Integration of Patient-reported Outcomes in Clinical Care. *Med Care.* 2015; 53(2):153–159. [PubMed: 25588135]
21. Black N. Patient reported outcome measures could help transform healthcare. *BMJ.* 2013; 346:f167. [PubMed: 23358487]
22. Cella D, Yount S, Rothrock N, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS): Progress of an NIH Roadmap Cooperative Group During its First Two Years. *Med Care.* 2007; 45(5 Suppl 1):S3–S11.
23. Marshall S, Haywood K, Fitzpatrick R. Impact of patient-reported outcome measures on routine practice: a structured review. *J Eval Clin Pract.* 2006; 12(5):559–568. [PubMed: 16987118]
24. Greenhalgh J. The applications of PROs in clinical practice: what are they, do they work, and why? *Qual Life Res.* 2009; 18(1):115–123. [PubMed: 19105048]
25. Payne TH, Corley S, Cullen TA, et al. Report of the AMIA EHR 2020 Task Force on the Status and Future Direction of EHRs. *J Am Med Inform Assoc.* 2015
26. Chen J, Ou L, Hollis SJ. A systematic review of the impact of routine collection of patient reported outcome measures on patients, providers and health organisations in an oncologic setting. *BMC Health Serv Res.* 2013; 13(1):1–24. [PubMed: 23286781]
27. Valderas JM, Kotzeva A, Espallargues M, et al. The impact of measuring patient-reported outcomes in clinical practice: A systematic review of the literature. *Qual Life Res.* 2008; 17
28. Valderas JM, Kotzeva A, Espallargues M, et al. The impact of measuring patient-reported outcomes in clinical practice: a systematic review of the literature. *Qual Life Res.* 2008; 17(2): 179–193. [PubMed: 18175207]
29. Campbell MK, Piaggio G, Elbourne DR, Altman DG. Consort 2010 statement: extension to cluster randomised trials. *BMJ.* 2012; 345
30. Schulz KF, Altman DG, Moher D. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *BMJ.* 2010; 340
31. Zwarenstein M, Treweek S, Gagnier JJ, et al. Improving the reporting of pragmatic trials: an extension of the CONSORT statement. *BMJ.* 2008; 337
32. American Society of Anesthesiologists Task Force on Chronic Pain Management and the American Society of Regional Anesthesia and Pain Medicine. Practice Guidelines for Chronic Pain Management. *Anesthesiology.* 2010; 112(4):810–833. [PubMed: 20124882]
33. Delitto A, George S, Van Dillen L, et al. Low back pain. *Journal of Orthopaedic and Sports Physical Therapy.* 2012; 42(4):A1–57.
34. Manchikanti L, Abdi S, Atluri S, et al. American Society of Interventional Pain Physicians (ASIPP) guidelines for responsible opioid prescribing in chronic non-cancer pain: Part 2-guidance. *Pain Physician.* 2012; 15(3 suppl):S67–116. [PubMed: 22786449]
35. Webster LR, Webster RM. Predicting Aberrant Behaviors in Opioid-Treated Patients: Preliminary Validation of the Opioid Risk Tool. *Pain Med.* 2005; 6(6):432–442. [PubMed: 16336480]
36. Stanford Systems Neuroscience and Pain Lab. Collaborative Health Outcomes Information Registry (CHOIR). 2015. <https://choir.stanford.edu/>. Accessed 1 August, 2016

37. Sturgeon JA, Darnall BD, Kao M-CJ, Mackey SC. Physical and Psychological Correlates of Fatigue and Physical Function: A Stanford-NIH Open Source Pain Registry Study. *J Pain*. 2015; 16(3):291–298.e291. [PubMed: 25536536]
38. Broderick JE, DeWitt EM, Rothrock N, Crane PK, Forrest CB. Advances in Patient-Reported Outcomes: The NIH PROMIS(®) Measures. *eGEMS*. 2013; 1(1):1015. [PubMed: 25848562]
39. National Institutes of Health. PROMIS – Dynamic Tools to measure Health Outcomes from the Patient Perspective. 2015. <http://nihpromis.org/>. Accessed 2 Feb, 2015
40. Tan G, Jensen MP, Thornby JI, Shanti BF. Validation of the brief pain inventory for chronic nonmalignant pain. *J Pain*. 2004; 5(2):133–137. [PubMed: 15042521]
41. Giordano LA, Elliott MN, Goldstein E, Lehrman WG, Spencer PA. Development, Implementation, and Public Reporting of the HCAHPS Survey. *Medical Care Research and Review*. 2009
42. Suchman AL, Roter D, Green M, Lipkin M Jr. Physician Satisfaction with Primary Care Office Visits. *Med Care*. 1993; 31(12):1083–1092. [PubMed: 8246638]
43. Beasley JW, Wetterneck TB, Temte J, Lapin JA, Smith P, Rivera-Rodriguez AJ. Information chaos in primary care: implications for physician performance and patient safety. *J Am Board Fam Med*. 2011; 24
44. Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. Electronic Health Record Use and the Quality of Ambulatory Care in the United States. *Arch Intern Med*. 2007; 167(13):1400–1405. [PubMed: 17620534]
45. Greenhalgh J, Long AF, Flynn R. The use of patient reported outcome measures in routine clinical practice: Lack of impact or lack of theory? *Soc Sci Med*. 2005; 60
46. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *BMJ*. 2005; 330(7494):765. [PubMed: 15767266]
47. Harle CA, Listhaus A, Covarrubias CM, et al. Overcoming barriers to implementing patient-reported outcomes in an electronic health record: a case report. *J Am Med Inform Assoc*. 2015
48. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Serv Res*. 2010; 10(231)
49. Lorenzi, NM., T, RR. *Managing Technological Change*. 2. New York: Springer; 2003.
50. Becker G, Newsom E. Socioeconomic Status and Dissatisfaction With Health Care Among Chronically Ill African Americans. *American Journal of Public Health*. 2003; 93(5):742–748. [PubMed: 12721135]
51. Haviland MG, Morales LS, Dial TH, Pincus HA. Race/Ethnicity, Socioeconomic Status, and Satisfaction With Health Care. *American journal of medical quality : the official journal of the American College of Medical Quality*. 2005; 20(4):195–203. [PubMed: 16020676]
52. Sorkin DH, Ngo-Metzger Q, De Alba I. Racial/Ethnic Discrimination in Health Care: Impact on Perceived Quality of Care. *J Gen Intern Med*. 2010; 25(5):390–396. [PubMed: 20146022]
53. Weech-Maldonado R, Morales LS, Elliott M, Spritzer K, Marshall G, Hays RD. Race/Ethnicity, Language, and Patients' Assessments of Care in Medicaid Managed Care. *Health Services Research*. 2003; 38(3):789–808. [PubMed: 12822913]
54. National Institutes of Health (NIH). 2015. <http://iprcc.nih.gov/docs/DraftHHSNationalPainStrategy.pdf>

**Table 1**

Patient Overall and Pain-Related Satisfaction with Visits

	Education Phase			PRO Phase		
	Control Mean	Intervention Mean	Intervention – Control	Control Mean	Intervention Mean	Intervention – Control
Overall visit rating (0–10)	9.33 (0.16)	9.08 (0.10)	–0.25 (0.19) [0.20]	9.28 (0.14)	9.01 (0.14)	–0.27 (0.20) [0.20]
Doctor did everything he/she could to help your pain (1–5)	3.99 (0.18)	3.86 (0.12)	–0.13 (0.22) [0.58]	3.93 (0.17)	3.84 (0.16)	–0.09 (0.23) [0.71]
Confidence that future pain will be controlled (1–5)	3.63 (0.19)	3.55 (0.12)	–0.08 (0.22) [0.73]	3.48 (0.18)	3.53 (0.17)	0.05 (0.24) [0.83]

Note: Entries are Mean (SE) [P-Value, 2 sided] patient satisfaction scores for PCPs (n=21) in intervention and control groups. Weighted least squares analysis was used with weights proportional to the physicians' patient sample sizes. Due to survey non-response, N=676 for overall visit rating, 675 for doctor did everything he/she could to help your pain, and 670 for confidence that future pain will be controlled. Descriptive patient analysis can be found in Appendix section 2. Complete questions wording can be found in Appendix section 4.

**Table 2**

Unadjusted Baseline, Post-Education and Post-PRO Satisfaction with Providing Pain Care

	Baseline		End Education Phase		End PRO Phase	
	Intervention	Control	Intervention	Control	Intervention	Control
Overall Score	2.87 (0.42)	3.01 (0.34)	2.98 (0.42)	2.94 (0.29)	3.18 (0.32)	3.02 (0.32)
Relation Score	3.07 (0.43)	3.22 (0.49)	3.36 (0.38)	3.23 (0.36)	3.33 (0.33)	3.28 (0.28)
Data Score	2.64 (0.72)	2.82 (0.53)	2.76 (0.63)	2.30 (0.58)	2.90 (0.52)	2.60 (0.72)
Time Score	3.42 (0.67)	3.48 (0.44)	3.39 (0.65)	3.53 (0.53)	3.70 (0.53)	3.42 (0.72)
Demand Score	2.52 (0.46)	2.78 (0.73)	2.39 (0.53)	2.67 (0.63)	2.83 (0.53)	2.73 (0.52)

Note: All estimates are unadjusted means and standard deviations of average PCP satisfaction (N=21) in response to monthly surveys of their satisfaction with pain care overall, relationships with patients with chronic pain, access to needed data on patients with chronic pain, value of time spent with patients with chronic pain, and time/demand placed on them by patients with chronic pain. Complete questions wording can be found in Appendix section 5.

**Table 3**

Adjusted Within-Phase Differences between Intervention and Control Groups in PCP Satisfaction with Providing Pain Care

	<b>Education Phase Control – Intervention</b>	<b>PRO Phase Control – Intervention</b>
Overall Score	–0.09 (0.11) [0.43]	–0.09 (0.05) [0.10]
Relation Score	–0.13 (0.11) [0.26]	–0.02 (0.08) [0.85]
Data Score	–0.15 (0.18) [0.42]	–0.14 (0.15) [0.34]
Time Score	0.01 (0.17) [0.95]	–0.20 (0.10) [0.06]
Demand Score	0.03 (0.15) [0.86]	–0.14 (0.09) [0.12]

Note: Estimates are Mean (SE) [P-Value, 2 sided] of PCP satisfaction (N=21). Results adjusted for score at baseline of phase (i.e., education phase is adjusted for baseline; PRO phase is adjusted for end of education phase.)